Polyphenols and health. Focused and directed studies.

Analysis of polyphenols in foods, functional ingredients and biological samples.

- Cocoa, citrus, green tea, wine.
- Metabolites of cocoa flavanols and cocoa flavonols. [1]
- Resveratrol in c-LDL, urine, plasma and tissues. [2]
- Metabolites of catechins and gallates form green tea.
- Metabolites of flavanones in citrus fruits.
- Metabolites of blueberries in the Central Nervous System. [3]

GROUP PUBLICATIONS:


Berries

As well as taste, color is one of the qualities that influences human beings’ choice of some types of foods. Red, blue and violet are the attractive colors that tempt us to consume berries; these colors are created by a high level of anthocyanines. Much research has been carried out which suggests that polyphenolic compounds contained in fruits and their vehicles, rich in color, can have antioxidant properties as well as potent anti-inflammatory activities. The most abundant dietary flavonoids are flavonols (catechins and proanthocyanidins), anthocyanins and their oxidation products.

These studies were not conclusive since some phytochemicals of cranberries (BB) could have direct access to the brain after dietetic supplementation. In fact, while many studies have examined the plasma levels of flavonoids such as anthocyanins, no study has determined anthocyanins in the brain after supplementation. So, our study set out to determine whether different classes of anthocyanins could be found in the brain areas associated with cognitive and/or motor functioning after...
supplementation of BB (BBS).

Aged rats were fed with a diet of 2% of BB for 8 to 10 weeks. Anthocyanin tests were carried out on the diet as well as on different regions of the rats’ brains (cerebellum, striatum cortex and hypocampus) for the control and conditions of the BBS. New techniques were applied in this investigation as we thought that because of the low quantities in the diet, low quantities of anthocyanins would be found. These techniques helped us to reach the detection levels of these compounds. Measurements were carried out with liquid chromatography (LC) along with spectrometry, total electrospray positive mode (ESIMS/MS) with two instruments: I) one total spectrophotometer with ion tramp and II) one mass quadrupole triple spectrophotometer.

Results indicated that anthocyanins were found in all brain regions of the BBS rats. These were found mainly in the cortex and hypocampus. To our knowledge this is the first time that anthocyanins have been identified with the diet supplement in the fine tissue of the cerebellum. Our results demonstrate that anthocyanins can pass the blood brain barrier in the glycosylated form and can be localized in several important regions that affect memory and understanding. At the same time they can have an antioxidant effect.

In this way an optimum product such as cranberries may have important advantages in the progression index of neurodegenerative disease preserving the normal neuronal functioning.

This study was carried out in collaboration with:

- USDA Human Nutrition Research on Aging, Neuroscience Laboratory at Tufts University, USA;
- Dep. of Psychology, Simmons College, USA;
- Department of Nutrition & Food Science-CeRTA, University of Barcelona Spain;
- Scientific and Tecnical Services, University of Barcelona, Spain.

References:


GROUP PUBLICATIONS:


Cocoa, cocoa powder and chocolate

Cocoa is one of the nutritional elements that is richest in polyphenols, principally those of the flavonoid group, especially the flavan-3-oles group (catechins, epicatechins and their oligomers the procanidines), although flavonols such as quercetin and its glucosides and antocians can also be found.
Recently it has been demonstrated that cocoa flavonoids and their derivatives present a great variety of benefits in the prevention of cardiovascular and degenerative diseases:

1. Protective antioxidant action against free radicals and other degenerative species, therefore preventing LDL oxidation.
2. Modulation of vascular homeostasis, inhibiting the platelet aggregation.

The most popular way of consuming cocoa is as chocolate or as other types of related products which contain cocoa. Nevertheless, in many countries one of the main sources of cocoa is the so-called cocoa soluble, a cocoa product which dissolves in milk or water and is used as a breakfast beverage. The Spanish population is the biggest consumer of cocoa solubles in the world, 1.7 kg/person/year. Other countries such as Norway, Sweden, France, Brazil, Austria and Australia also have a high consumption index.

The beneficial effects of polyphenols would depend on the quantity of consumption, bioavailability and the biological activity of the conjugates formed during the metabolism and excretion. This is why in this project we are researching the types of metabolites formed and their concentration in blood and urine in healthy volunteers after the consumption of a mixture of cocoa containing 40 g of cocoa solubles. At the same time, we are investigating whether milk influences the absorption and/or excretion of these metabolites, and the antioxidant capacity of the different excreted metabolites.

GROUP PUBLICATIONS:

- Urpi-Sarda M, Monagas M, Khan N, Llorach R, Lamuela-Raventös RM, Jáuregui O, Estruch R,


**Resveratrol**

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Resveratrol (3, 5, 4’-trihydroxystilbene) is a stilbenic phenolic compound mainly present in grape products, as free form, and as glucoside (resveratrol-3-O-glucoside). Resveratrol is of great interest in nutrition and medicine due to its potential health benefits, such as anti-carcinogenic, neuroprotector and antioxidant effects, as a modulator of lipid and lipoprotein metabolism, antiplatelet aggregator, and its estrogenic activity. Indeed, it has been hypothesized that resveratrol uses the same pathways activated by caloric restriction. The biological effects have been studied mainly in vitro, although there is also growing in vivo evidence. Some effects, such as antioxidant effects, require a high concentration of resveratrol in tissues, although chemopreventive and chemotherapeutic anti-cancer effects are an exception. In this case, resveratrol affects the activity of transcriptional factors involved in proliferation and stress responses and leads to the modulation of survival and apoptotic factors in carcinogenesis. In atherosclerotic and neurodegenerative diseases, the effects of resveratrol are not only due to its antioxidant and scavenging activities, but also to its participation in the modulation of signal transduction pathways and in the activation of several enzymes at micromolar concentrations.

At present, studies are focusing on the bioavailability of resveratrol in humans. It is reasonably well absorbed from the gut but its bioavailability is low. Therefore, the benefits on health attributed to the ingestion of resveratrol are most likely related to biologically active metabolites. In this context, the characterization of its metabolic profile in vivo and specifically in humans will help to show which metabolites may interact to produce a signal or reach target organs and therefore be responsible for the benefits of resveratrol on health.

Our research group, across clinical and epidemiological studies, is focusing on the bioavailability of resveratrol in humans after a moderate consumption of grape products such as wine and sparkling wine. The utilization of mass spectrometry has enabled us to optimize very sensitive and selective methods to detect resveratrol and its metabolites in biological tissues: LDL, plasma, urine, SNC.

A nutritional biomarker is a compound or metabolite of itself that is measured in the organism (plasma, urine...) and is used to explain individual exposure to food. Nutritional biomarkers have several advantages according to data nutritional surveillance. A good nutritional biomarker should comply with several requisites: specificity, an adequate half life and a good correlation biomarker against ingestion. Resveratrol metabolites in urine can be used as biomarkers of moderate wine consumption.

We are currently participating in the PREDIMED study in order to prove the results of this large epidemiological study, in which individuals ingest different models of wine consumption (quantity and type).

**GROUP PUBLICATIONS:**

- Arias N et al. The combination of resveratrol and conjugated linoleic acid attenuates the individual effects of these molecules on triacylglycerol metabolism in adipose tissue. European Journal of Nutrition [in press]. PubMed [29]


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